

**** ASCII MODEMS *** PACKET RADIO MODEMS *** COMPUTER MODEMS ****

--- BELL 202 COMPATIBLE, 1200 BITS PER SECOND ---

RIXON-SANGAMO T202C & T202D & T202E

Recently the FCC opened the amateur bands to ASCII code transmission at speeds which far surpass the traditional RTTY rate of 45 Baud. For example, data transmission on 2 meters can now run at 1200 Baud, opening up new possibilities for computer-to-computer file exchange, packet radio, computer radio networks, automatic traffic handling between regions, and all sorts of new services which were unavailable previously.

To take advantage of this new service a station needs a computer (or at least a terminal), a modem and a radio. The modem converts the computer's digital signals to tones suitable for use on voice channels. There are many different modems currently in industrial use, but the Bell 202 type modem is quickly becoming the defacto standard for radio service at 1200 bps.

A Bell 202 modem is a frequency shift keying device which has a mark tone at 1200 Hz. and a space tone at 2200 Hz. These units generally operate in half-duplex mode (only one direction at a time) which is great for radio work, but a little inconvenient for telephone use. Some 202 units have a low speed reverse channel which allows full duplex signalling on a phone circuit. Since industry is currently adopting full-duplex 1200 bps modems, many 202 type units are appearing on the surplus market and can be purchased at very reasonable prices. There is no easier way to get your computer on the air.

In order to promote packet radio concepts and the greater use of ASCII on the air, Hank Magnuski, KA6M, purchased a large quantity of Rixon/Sangamo T202 modems which were being dumped by an industrial broker. Rixon/Sangamo is one of the leading and most reputable modem manufacturers in the country. These modems were built around 1970 from discrete components and are very rugged and serviceable. The manufacturer has been most cooperative in providing us with technical documentation on these modems, and we now have copies of the complete service manuals. The modems are being refurbished and checked out by Explorer Post 599, and various checks are made to insure that the units function. The prices are hard to beat:

T202D	8 Card unit for 2-wire or 4-wire service	\$75
T202D	10 Card unit includes slow speed reverse channel	\$85
T202C	11 Card unit with reverse channel and auto answer	\$90
T202E	3 Card unit with transmit only capabilities	\$50

For more information contact:

Hank Magnuski, KA6M, 415-854-1927

RIXON-SANGAMO T202 MODEM NOTES AND INSTRUCTIONS

The following are suggested starting configurations for use of the modems. Try the given arrangements first and then optimize the settings for your particular installation and usage.

1. T202D Modem for use in Packet Radio service or ASCII transmissions:
(Four-wire, full duplex service with no echo)

Card Jumper Settings

TEST: ZE ZE N N Y Y
XMTR: ZY 0-6 SC
FILTER: NQ 6 A A
EQUAL: no jumpers
RCVR: ZB
CARDET: RC V ZL
IN-OUT: E ZE ZH ZJ X X N
RELAY: N NQ

TB1 - Terminal Board 1 in back of unit

1 Receive Data Tip connection
3 Receive Data Ring connection
4 Transmit Data Tip connection
6 Transmit Data Ring connection
5 to 28 Reverse channel out
27 to 29 Reverse channel out
19 to 23 804 Data Access Set out

Note: TB4-TB6 connect to the radio's audio input circuit through a voltage divider. A divider consisting of a 560 ohm and 22 ohm resistor connected in series will properly terminate the modem. A tap across the 22 ohm resistor will supply approximately 15 millivolts of audio for the transmitter. Terminals TB1 and TB3 supply received audio to the modem and the connection may be made across the radio's speaker or earphone output. The modem's receiver has a threshold of about 5 millivolts. It has a very large dynamic range. The modem's input and output impedance is either 600 or 900 ohms.

The following DB-25 RS-232 signals are required:

2 Transmit Data
3 Receive Data
4 Request to Send
7 Signal ground
20 Data Terminal Ready

The following are suggested starting configurations for use of the modem. Try the given arrangements first and then optimize the settings for your particular installation and needs.

1. 1200B Modem for use in Packet Radio service or 1800B transmission:
(Point-to-point, full duplex service with no echo)

Card Reader Settings

TEST: 20 20 20 20 20
 XMIT: 20 20 20 20 20
 FILTER: 10 20 20 20 20
 ECHO: 20 20 20 20 20
 RCVR: 20 20 20 20 20
 DATAB: 20 20 20 20 20
 T-OUT: 20 20 20 20 20
 T-INT: 20 20 20 20 20

Terminal Board in Back of unit

1	Receive Data 1 to connection
2	Receive Data 2 to connection
3	Receive Data 3 to connection
4	Receive Data 4 to connection
5	Receive Data 5 to connection
6	Receive Data 6 to connection

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Note: 1200B-TBS connect to the radio's audio input circuit through a voltage divider. A divider consisting of a 250 ohm and 25 ohm resistor connected in series will properly terminate the modem. A tap across the 25 ohm resistor will supply approximately 1/2 millivolt of audio for the transmitter. Terminals T1 and T2 supply received audio to the modem and the connection may be made across the radio's speaker or earphone output. The modem's receiver has a threshold of about 2 millivolts. It has a very large dynamic range. The modem's input and output impedance is about 600 or 100 ohms.

The following 1200B RS-232 signals are required:

1	Transmit Data
2	Receive Data
3	Receive to Send
4	Signal Ground
5	Modem Ready

2. T202D Modem for use in switched DDD service with 804A DATA AUX SET.
(Two-wire, half duplex service with echo and key controlled auto answer.)

Card Jumper Settings

TEST: ZF ZF N N Z Z
XMTR: ZY 0-6 SC
FILTER: Q 6 B B
EQUAL: no jumpers
RCVR: ZB
CARDET: RC V R
IN-OUT: F ZG ZF W W N, remove ZJ
RELAY: N Q

TB1 - Terminal Board 1 in back of unit

5 to 28 Reverse channel out
27 to 29 Reverse channel out
19 to 25 804A Data Access Set in

Note: First configure the circuit boards as outlined above. Next, put in the three jumpers as specified on TB1. Now wire the 25 conductor cable as specified in diagram 8-T as found on page 8-41 of the manual. The connection to the phone company jack is made using the two wires coming from pins 1, 26 found at the top of the page. Finally, wire the options on the 804A using Figure 3-I on page 3-12. The second row corresponds to 8-T. Selections J, Q, W, X, E, H, ZA and ZM are recommended. Caution: do not apply power until this wiring is completed as 18 volts could damage a 12-volt wired set.

The following DB-25 RS-232 signals are required:

2	Transmit Data
3	Receive Data
4	Request to Send
7	Signal ground
20	Data Terminal Ready

3. T202C Modem for use in switched DDD service.
(Two-wire, half duplex service with echo and key controlled auto answer.)

Card Jumper Settings

TEST: ZF ZF N N Z Z
XMTR: ZY 0-6 SC
FILTER: Q 6 B B
EQUAL: no jumpers
RCVR: ZB
CARDET: RC V R
IN-OUT: F ZG ZF W W N, remove ZJ
RELAY: N Q
RVCH T: 6
RVCH R: no jumpers
CONTROL: no jumpers

TB1 - Terminal Board 1 in back of unit

1 to 28 Reverse channel in
3 to 27 Reverse channel in
5 to 37 Reverse channel in
29 to 38 Reverse channel in

19 to 33 6017 AP test key not used

TB2 - Terminal Board 2 in back of unit

1 to 11 Two wire connection
2 to 12 Two wire connection
3 to 13 Two wire connection
4 to 14 Two wire connection

9 to 19 Key controlled auto answer

Note: First configure the circuit boards as outlined above. Next, put in the five jumpers as specified on TB1 and the five jumpers specified for TB2. The connection to the phone line is made via TB2-1 (CO Tip, green) and TB2-4 (CO Ring, red). The auto-answer key is wired from TB2-9 to TB2-10. A DPST switch is all that is required to make the modem hold the telephone line. On SW1 of the DPST wire NO to TB1-24 and COMMON to TB2-6. On SW2 of the DPST wire NO to TB2-1, COMMON through an 820 resistor to TB2-8. When DTR is ready and the phone line is connected, momentarily pressing the switch will cause the modem to hold the line. To auto answer, short TB2-9 to TB2-10.

The following DB-25 RS-232 signals are required:

2	Transmit Data
3	Receive Data
4	Request to Send
7	Signal ground
11	Reverse Channel Transmit
12	Reverse Channel Receive
20	Data Terminal Ready

SKD

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DE K6VCO, STU

MBX TYPE 446

NR 446 QST DE W6RAW 1133 11/20

THE FOLLOWING IS FROM THE NOV/DEC 1980 HOMEBREW COMPUTER NEWSLETTER:

RECENTLY THE FCC OPENED THE AMATEUR BANDS TO ASCII CODE TRANSMISSION AT SPEEDS WHICH FAR SURPASS THE TRADITIONAL RTTY RATE OF 45 BAUD. FOR EXAMPLE, DATA TRANSMISSION ON 2 METERS CAN NOW RUN AT 1200 BAUD, OPENING UP NEW POSSIBILITIES FOR COMPUTER TO COMPUTER FILE EXCHANGE, PACKET RADIO, COMPUTER RADIO NETWORKS, AUTOMATIC TRAFFIC HANDLING BETWEEN REGIONS, AND ALL SORTS OF NEW SERVICES WHICH WERE UNAVAILABLE PREVIOUSLY.

TO TAKE ADVANTAGE OF THIS NEW SERVICE A STATION NEEDS A COMPUTER (OR AT LEAST A TERMINAL), A MODEM AND A RADIO. THERE ARE MANY DIFFERENT MODEMS CURRENTLY IN INDUSTRIAL USE, BUT THE BELL 202 TYPE MODEM IS QUICKLY BECOMING THE DEFACTO STANDARD FOR RADIO SERVICE AT 1200 BPS.

A BELL 202 MODEM IS A FREQUENCY SHIFT KEYING DEVICE WHICH HAS A MARK TONE AT 1200 HZ AND A SPACE TONE AT 2200 HZ. THESE UNITS GENERALLY OPERATE IN HALF-DUPLEX MODE (ONLY ONE DIRECTION AT A TIME) WHICH IS GREAT FOR RADIO WORK, BUT A LITTLE INCONVENIENT FOR TELEPHONE USE. SOME 202 UNITS HAVE A LOW SPEED REVERSE CHANNEL WHICH ALLOWS FULL DUPLEX SIGNALLING ON A PHONE CIRCUIT. SOME ... SINCE INDUSTRY IS CURRENTLY ADOPTING FULL-DUPLEX 1200 BPS MODEMS, MANY 202 TYPE UNITS ARE APPEARING ON THE SURPLUS MARKET AND CAN BE PURCHASED AT VEWRY REASONABLE PRICES. THERE IS NO EASIER WAY TO GET YOUCOMPUTER ON THE AIR.

IN ORDER TO PROMOTE PACKET RADIO CONCEPTS AND THE GREATER USE OF ASCII ON THE AIR, HANK MAGNUSKI, KA6M, PURCHASED A LARGE QUANTITY OF RIXON/ SANGAMO T202 MODEMS WHICH WERE BEING DUMPED BY AN INDUSTRIAL BROKER. RIXON/SANGAMO IS ONE OF THE LEADING AND MOST REPUTABLE MODEM MANUFACTURERS IN THE COUNTRY. THESE MODEMS WERE BUILT AROUND 1970 FROM DISCRETE COMPONENTS AND ARE VERY RUGGED AND SERVICEABLE. THE MANUFACTURER HAS BEEN MOST COOPERATIVE IN PROVIDING US WITH TECHNICAL DOCUMENTATION ON THESE MODEMS, AND WE NOW HAVE COPIES OF THE COMPLETE SERVICE MANUALS. THE MODEMS ARE BEING REFURBISHED AND CHECKED OUT BY EXPLORER POST 599, AND VARIOUS CHECKS ARE MADE TO INSURE THAT THE UNITS FUNCTION. THE PRICES ARE HARD TO BEAT:

T202D, 8 CARD UNIT FOR 2-WIRE OR 4-WIRE SERVICE, \$75, T202D, 10 CARD UNIT INCLUDES SLOW SPEED REVERSE CHANNEL, \$85, T202C, 11 CARD UNIT INCLUDES REVERSE CHANNEL AND AUTO ANSWER, \$90, T202E, 3 CARD UNIT WITH TRANSMIT ONLY CAPABILTIES, \$50.

FOR MORE INFORMATION CONTACT: CHRIS SCHELLENBER, WB6WBK, (415) 324-4591. JOHN BUONOCORE, KA6CUG, (415) 366-1658, HANK MAGNUSKI, KA6M, (415) 854-1927.

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NR 448 QST DE W6RAW 1133 1175Z
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324-1527, JOHN BUONOCORE, KACUG, (415) 366-1558, HANK MAGNUSKI, K8AM,
(415) 324-1527.

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4545 baud
163 a

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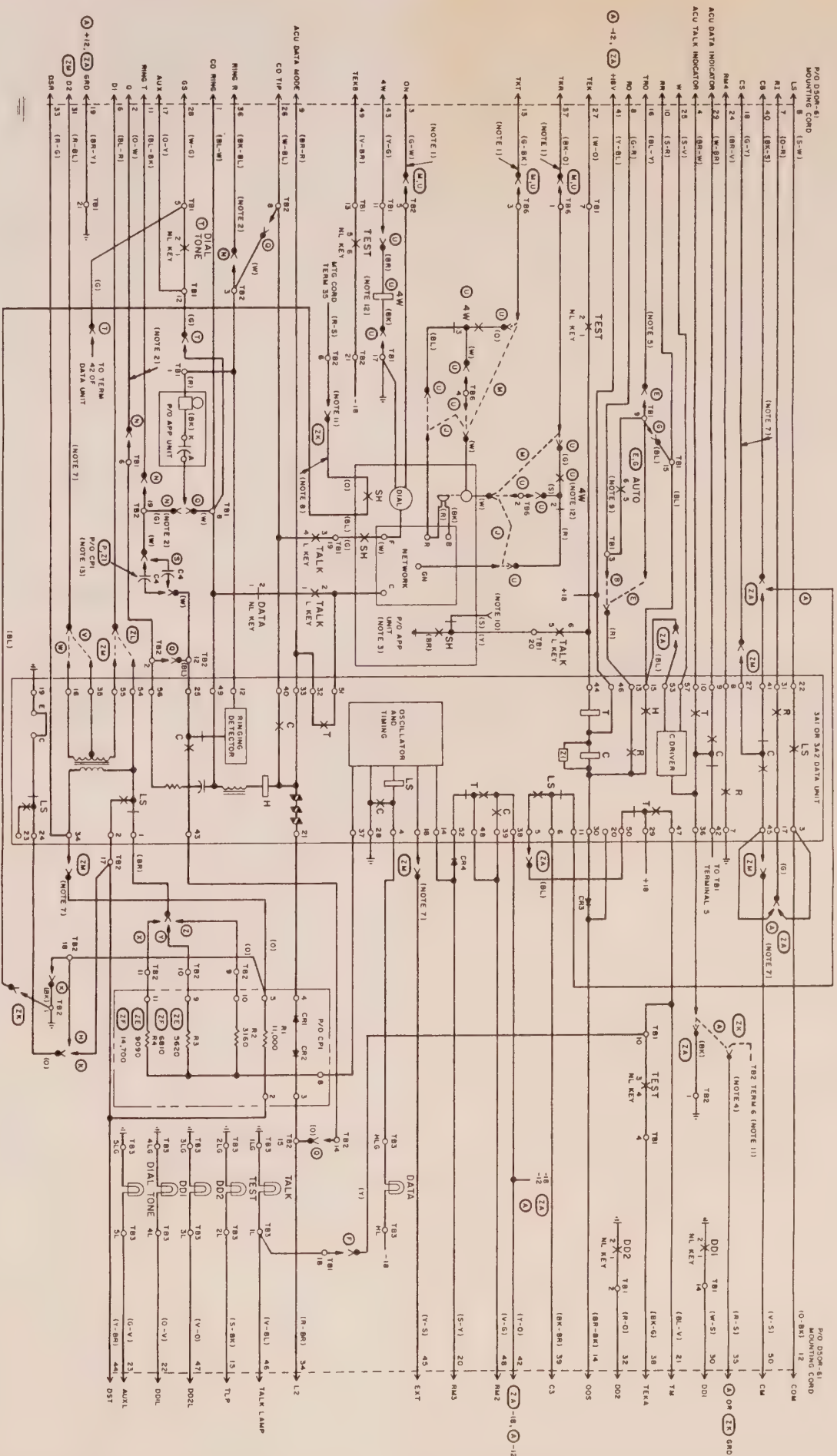
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67 wpm

61 wpm



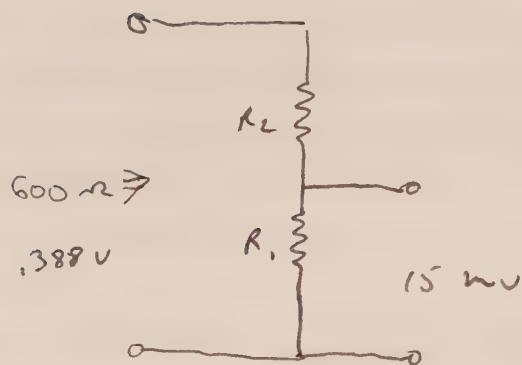
- NOTES:
1. TAPE AND STORE WHEN (2) OPTION IS PROVIDED.
 2. TAPE AND STORE WHEN (3) OPTION IS PROVIDED.
 3. DIFFERENCES IN THE APP UNITS ARE AS SHOWN BY INSERTS BELOW.
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Figure 8-M. 804A Data Auxiliary Set
Schematic Diagram

CHRIS SCHELLENBERG

WBC W3K

415 324 4591



$$R_1 + R_2 = 600$$

$$\frac{R_1}{R_1 + R_2} = \frac{.015}{.388} = \frac{R_1}{600}$$

$$R_1 = 23.18 \Omega \quad 22 \Omega$$

$$R_2 = 576.8 \Omega \quad 560 \Omega$$

$$dB = 10 \log \frac{P_1}{P_2}$$

$$-6 \text{ dBm} = 10 \log \frac{P_1}{P_0} \quad -.6 = \log \frac{P_1}{P_0} \quad 10^{-.6} = .251189$$

$$P = IE = \frac{E^2}{R} \quad .000251189 \cdot 600 = P \quad E = .38822 \text{ Volts}$$

6	RED	VCC
4	BLK	GND
2	BRN	SPKR
1	PUR	BLK
3	BLU/WHY	PTT
5	Yellow	SQ

5.218 \Rightarrow idle channel 0 \Rightarrow busy "Channel Free"

$$1200 \times 32 = 38400$$

$$1 \times 10^6 / 26 = 38461 \div 2 = 1201.923$$

$$26_{10} = 1A$$

T202 D JUMPER SETTINGS FOR PACKET RADIO

TEST: ZE ZE N N Y Y

XMTR: ZY 0-6 SC

FILTER: NQ G A A

RCVR: ZB

CAR-DET: RC V ZL

IN-OUT: E ZE ZH ZJ X X N

RELAY: N NQ

TB1 1 GREEN RECEIVE PAIR
3 RED

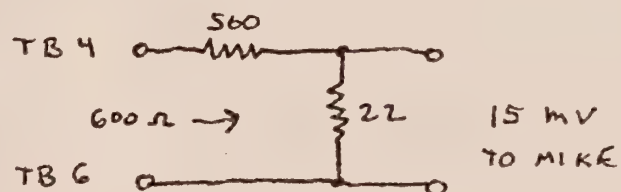
4 WHITE TRANSMIT PAIR
6 BLUE

5-28 REVERSE CHANNEL OUT
27-29))

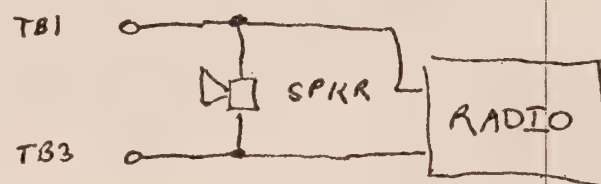
19-23 804 DAS OUT

39-40 Needed for some to receive, set with TB2

TRANSMIT MIKE CIRCUIT EXAMPLE



RECEIVER CIRCUIT



5mV to 500 mV range

DB 25 P SIGNALS REQUIRED

- 2 TRANSMIT DATA
- 3 RECEIVE DATA
- 4 REQUEST TO SEND
- 7 SIGNAL GROUND
- 20 DATA TERMINAL READY

T61-39 → J9-10 → J13-9 → T62-3

T61-40 → J5-12 → J13-2 → J3-10 → T61-9

TP3310, TP3311, TP3320, TP3321 Monolithic 1200/75 Bit/s FSK MODEM Family

General Description

The TP3320 and TP3321 are general purpose monolithic FSK (frequency shift-keyed) MODEMs implemented with National's advanced double-poly CMOS process (P²CMOS™). They are capable of generating and receiving frequency modulated signals at data rates from 0 to 600 bit/s or from 0 to 1200 bit/s on voice-grade telephone lines. The operating mode can be half-duplex with a backward channel on two-wire lines or full-duplex on four-wire lines. The TP3320 and TP3321 are offered in a 20-pin package and are capable of operating according to three standards:

- CCITT V23 at 1200 bit/s, with backward channel at 75 bit/s.
- CCITT V23 at 600 bit/s, with backward channel at 75 bit/s.
- BELL 202 at 1200 bit/s, with backward channel at 5 bit/s.

The standard and the operating mode are pin selectable.

In half-duplex mode the forward and reverse channels can be used simultaneously while still maintaining excellent distortion and error-rate performance.

All filtering functions required for frequency generation, out-of-band noise rejection and demodulation are performed by on-chip switched capacitor filters.

All internal frequencies are generated from an inexpensive 3.579545 MHz TV color-burst crystal reference. The buffered master clock is made available for external use on one of the pins.

Two baud rate clocks CLK_X and CLK_R are also provided by the MODEM to synchronize the transmit and the receive section of a UART. The frequency of each clock is 16 times the baud rate for the associated direction (75 × 16 Hz, 600 × 16 Hz or 1200 × 16 Hz, depending on the operating mode).

The handshaking protocol of the TP3320 and TP3321 with the local data terminal is RS232C compatible. The self-test feature allows the user to locally test the forward and the reverse channel of the MODEM.

A power-down mode is provided to reduce the power consumption to less than 2 mW when the MODEM is inactive.

The TP3310 and TP3311 are 16-pin versions of the TP3320 optimized for VIEWDATA terminals and for applications where low cost and board area are important considerations. They are still complete half-duplex or full-duplex

MODEMs; but they only operate according to CCITT standard V23 with a 1200 bit/s main channel and a 75 bit/s backward channel.

To realize a low cost data terminal, the MODEM can be interfaced with a UART and a microprocessor as shown in *Figure 1*. The standard and the operating mode are controlled by the microprocessor. No external baud rate generator is needed.

Features

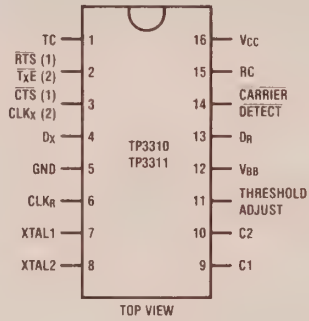
- ± 5V operation
- Low operating power dissipation: 75 mW (typical)
- Low standby power dissipation: 2 mW (typical)
- On-chip switched capacitor transmit and receive filters
- Uses inexpensive 3.579545 MHz television color-burst crystal
- BELL 202(s) compatible
 - 0–1200 bit/s with 5 bit/s reverse channel
 - 900 Hz soft carrier turn-off tone
- CCITT V23 compatible
 - 0–1200 bit/s with 75 bit/s reverse channel
 - 0–600 bit/s with 75 bit/s reverse channel
- Half-duplex operation on two-wire lines
- Full-duplex 1200 bit/s operation on four-wire lines
- Optimized UART interface
- Loopback test mode
- RS232C-type handshake signals

Applications

- Built-in medium speed MODEMs
- Stand-alone MODEMs
- VIDEOTEX or VIEWDATA terminals
- Remote data collection
- Point of sale terminals
- Credit verification systems
- Tape recorder interface
- Electronic mail

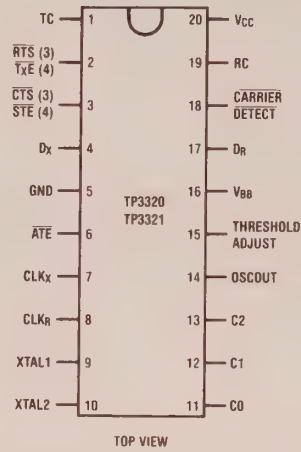
Connection Diagrams

Dual-In-Line Package



(1) TP3310
(2) TP3311

Dual-In-Line Package



(3) TP3320
(4) TP3321

Typical Application

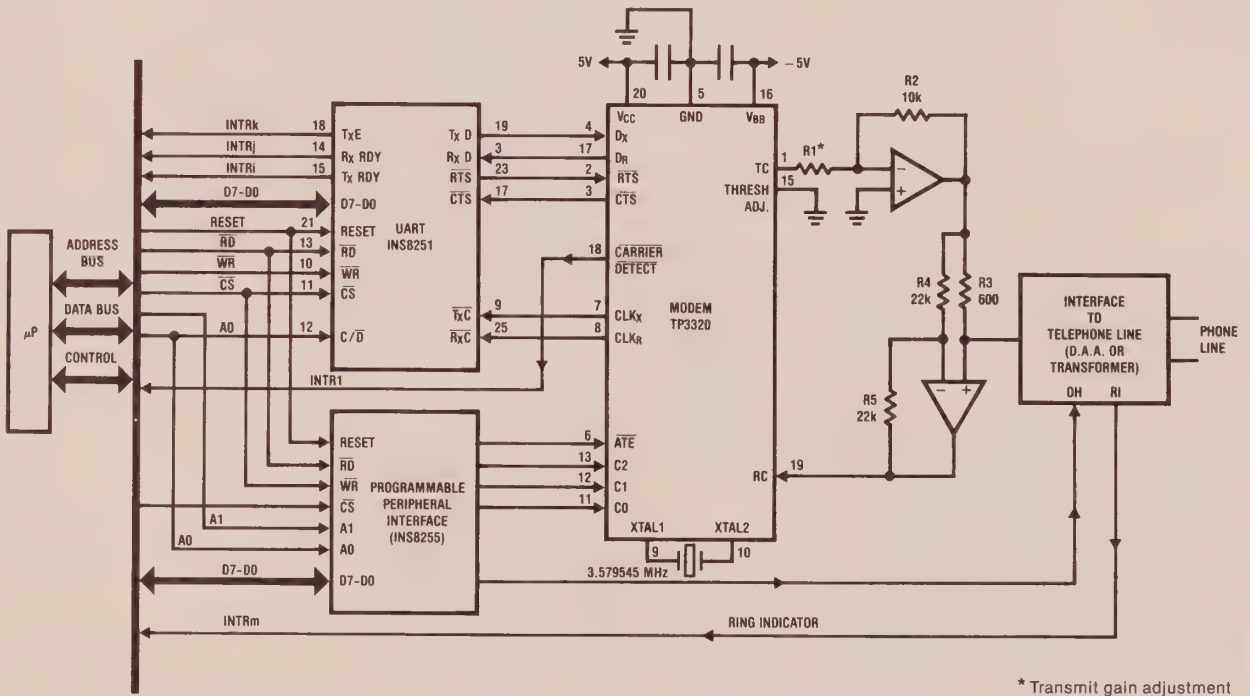
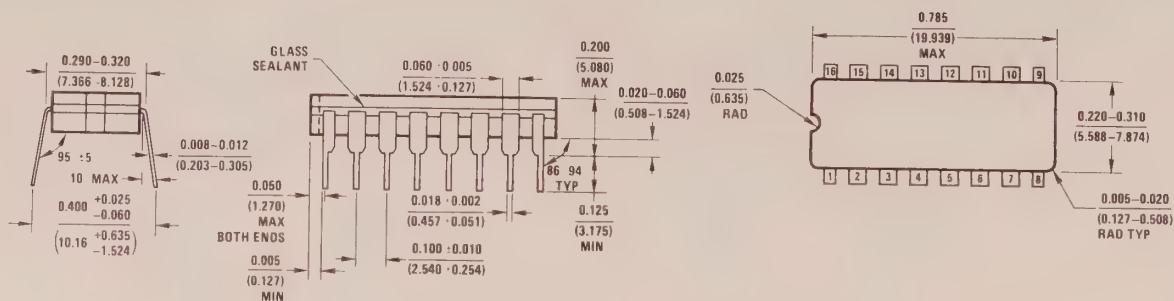


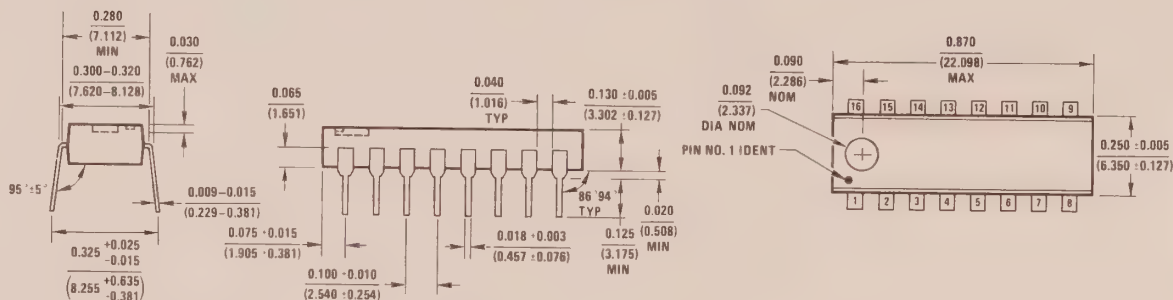
FIGURE 1. Interfacing the TP3320 with a Microprocessor

94

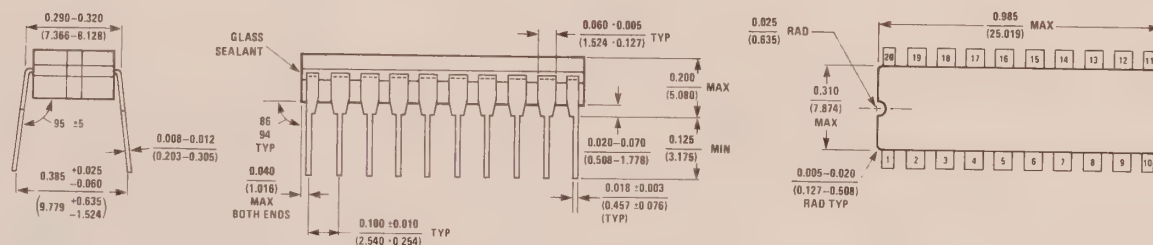
Physical Dimensions inches (millimeters)



Cavity Dual-In-Line Package (J)
Order Number TP3310J or TP3311J
NS Package Number J16A



Molded Dual-In-Line Package (N)
Order Number TP3310N or TP3311N
NS Package Number N16A



Cavity Dual-In-Line Package (J)
Order Number TP3320J or TP3321J
NS Package Number J20A

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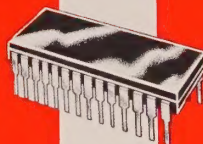
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